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OMSAPC

Advisory Circular

SUBJECT: Criteria for Determining the Acceptability of Service Accumulation on an Outdoor Chassis Dynamometer

I. Purpose

The purpose of this advisory circular (A/C), No. MC-3A, is to update the general criteria that are to be used to determine if service accumulation on a chassis dynamometer is adequately similar to service accumulation on a road route. This A/C supersedes A/C No. MC-3.

II. Background

A. Paragraph 40 CFR 86.426-78(a) specifies the use of prescribed road course durability driving schedules but allows the use of other service accumulation procedures which are approved in advance by the Administrator. Criteria for the approval of modified procedures which utilize chassis dynamometer simulators were published in the form of an A/C, No. MC-3, which was published on February 10, 1977. Authority for the approval of such procedures was subsequently transferred to the manufacturers in an EPA letter which was disseminated on March 16, 1981.

B. A/C No. MC-3 incorporated the approval criteria which had been adopted for light-duty vehicles on April 2, 1979 by the publication of A/C No. 35A. These criteria were subsequently revised for light-duty vehicles by the publication of A/C No. 35B on April 30, 1982. The changes in the evaluating, operating, monitoring and reporting requirements which were implemented for light-duty vehicles at that time have been incorporated in this revised motorcycle A/C, No. MC-3A.

III. Applicability

A. The provisions of A/C No. MC-3A are effective immediately and are applicable to gasoline-fueled motorcycles. The provisions apply to the use of an outdoor chassis dynamometer on which certification vehicles accumulate service.



B. The use of indoor chassis dynamometers for service accumulation is not approved.

IV. Discussion

A. As discussed in II.A. above, an applicant is no longer required to obtain EPA approval to use an outdoor chassis dynamometer for service accumulation. Instead the applicant can use the criteria which are set forth in this A/C to make engineering judgments regarding the accuracy with which a chassis dynamometer and its related systems simulate the temperature and load conditions that are experienced by a driver-controlled vehicle which is operated on a road route that meets the requirements of 40 CFR Part 86, Appendix IV.

B. There are many vehicle characteristics which can prevent the maintenance of representative temperatures and engine loads during operation on the chassis dynamometer. The applicant is responsible for assuring that the service accumulated on the chassis dynamometer is representative of service accumulated over the road route. This A/C contains only the basic parameters upon which each applicant will base engineering judgments regarding the similarity between chassis-dynamometer and a road-route service accumulation.

V. Minimum Demonstration Vehicles Needed to Support Similarity Between Chassis Dynamometer Operation and Road Route Operation

A. The applicant will obtain data (see paragraph VI) from at least one vehicle for each engine displacement class.

B. At a minimum, the applicant is to consider the following basic vehicle characteristics in selecting demonstration vehicles.

1. Catalyst or thermal reactor usage,
2. Catalyst or thermal reactor location,
3. Engine configuration (i.e., number of cylinders, in-line or V-type, water-cooled or air-cooled, 2-stroke or 4-stroke, displacement),
4. Vehicle shape and ground clearance,
5. Inertia weight class.



C. An applicant whose product line is very diverse needs to obtain data on as many vehicles as engineering judgment indicates is appropriate. (In the past, EPA selected a maximum of three vehicles per application.)

VI. Minimum Data Requirements Needed to Support Similarity Between Chassis Dynamometer Operation and Road Route Operation

A. In order to qualify a chassis dynamometer system, similarity must be shown in the data recorded from the demonstration vehicle(s) when driven on an existing approved test track route for at least three laps (laps 2, 9, and 11 for Class I and II vehicles and laps 4, 8, and 11 for Class III vehicles) of the Durability Driving Schedule, 40 CFR Part 86, Appendix IV, and when operated on a chassis dynamometer representative of the system(s) to be used. (The similarity in vehicle data may be determined on the basis of data recorded on one day or for a longer period.)

B. Data plots or recordings of the variables listed below shall be obtained continuously (or at intervals which are close enough to evaluate transient conditions) on a vehicle which is driven on an acceptable road route and on the chassis dynamometer:

Variable

1. Temperature

<u>Parameter to be Measured</u>	<u>Location of Thermocouple</u>
a. Cooling air	At front axle centerline (either side)
b. Engine inlet air	At the clean side of the air filter
c. Engine oil	In sump, at drainplug or near dipstick
d. Transmission oil	In sump, at drainplug or near dipstick
e. Spark plug seat (air-cooled engine)	One required for each spark plug (unless otherwise specified by EPA)
f. Coolant (liquid-cooled engine)	At both inlet and outlet of engine
g. Catalyst container (if applicable)	Skin at inlet and outlet

- h. Exhaust pipe Skin near connection to cylinder head
(one required for each pipe unless
otherwise specified by EPA)
 - i. Muffler Skin at outlet
2. Manifold vacuum, wheel (or dynamometer) torque, throttle position, or other indications of engine load
 3. Vehicle speed or wheel speed
 4. Engine speed

C. Data plots or recordings of the above variables shall be maintained as long as the data generated by these vehicles are used to satisfy 40 CFR Part 86 data requirements and shall be made available to EPA upon request.

VII. Minimum Acceptable Criteria

A. It is generally recognized that two drivers operating the same vehicle over the same test route and using the same prescribed driving schedule will show variations in driving patterns as reflected in manifold vacuum, acceleration rates, and temperature transients. It is, therefore, not necessary that the values of these parameters obtained on the dynamometer exactly duplicate the values obtained on the road. In addition, exact mechanical precision on the part of the road simulator is not considered an accurate simulation of the driver-controlled vehicle since few, if any, drivers are capable of accelerating, decelerating or driving a steady speed over a variable road terrain without random variations in the load-speed pattern. Therefore, the demonstrated simulated load-speed traces should show normal variations similar to, but not necessarily an exact replica of, those shown on the actual road-driven route.

B. The difference in temperature between road and dynamometer operation which are allowed will depend on the system being tested and the location of temperature-sensitive components. Generally, temperature versus time curves should agree within 5°C (10°F) for temperatures up to 40°C (100°F) and within 10 percent for temperature above 40°C (100°F).

C. The relation between engine speed and vehicle (or wheel) speed, both on the road and on the dynamometer, must be established in order to ascertain that transmission shift points on the dynamometer essentially duplicate the pattern observed on the road.



D. There is no specification in 40 CFR Part 86 relative to grade or condition of the road terrain, and a wide variety of grade and terrain conditions exist in the durability routes described by applicants in their applications for certification. A road simulator matching any approved durability route is satisfactory.

VIII. Authorization to Use Chassis Dynamometers

A. Each applicant will be responsible for determining whether the service that is accumulated on a chassis dynamometer is representative of road route operation. Paragraphs V, VI, and VII of this A/C set forth the minimum criteria upon which such a determination is to be made.

B. When an applicant has determined that there is adequate similarity between dynamometer and road-route operation, such determination is to be noted in the application for certification. The applicant should maintain the data and information used to make such determinations for as long as the information is applicable to a vehicle which was used to generate data to satisfy 40 CFR Part 86. In addition, these data and information must be made available to EPA upon request so that EPA can determine if data generated in support of certification was valid.

C. Applicants are reminded that, when an approved chassis dynamometer is used for service accumulation, the road route/dynamometer schedule used must be designated in the application for certification.

IX. Vehicle Operation on the Dynamometer

A. When a dynamometer system which controls manifold vacuum (or throttle position) is used, periodic checks must be made to determine if the manifold vacuum (or throttle position) as controlled on the chassis dynamometer continues to correspond to the actual load requirements on the road. These checks should be made at least once at an intermediate point during service accumulation. Discrepancies revealed by these checks must be corrected before service accumulation is continued.

B. Malfunctions to vehicles accumulating service on a chassis dynamometer must be recognized with no more time lag than would occur if the vehicle were accumulating service on the road.

1. Since the road simulator causes the driver to be eliminated from the feedback network, the applicant may utilize some type of monitoring system to detect any potential vehicle or dynamometer malfunction. This



approach is particularly desirable for a road simulator installation in which auxiliary power (electric motor or equivalent) is used to simulate inertia or downhill operation. With this type of installation, auxiliary power may compensate in case of vehicle malfunction or general vehicle deterioration by "driving" the crippled vehicle. If the applicant does not utilize such a detection system, frequent on-the-road evaluations must be made. These evaluations shall be made at the midpoint (± 250 km) of each service accumulation interval. Exhaust gas analysis is not an acceptable technique for determining vehicle or dynamometer malfunctions.

2. The provisions of §86.429-78(a)(1)(ii) require an overt indication of malfunction in order to justify unscheduled maintenance. A vehicle malfunction detected during dynamometer operation, can be verified either on the dynamometer or by an on-the-road evaluation to determine the need for unscheduled maintenance. If the verification is to be performed on-the-road, the test vehicle must be driven on an approved service accumulation road route.

C. The applicant has the option of alternating between an approved chassis dynamometer system and an approved service accumulation road route. However, a change from one system to the other must be recorded on the vehicle's service accumulation record and is to be made available to EPA upon request.

X. Data to be Recorded

A. For all vehicles accumulating distance on a chassis dynamometer, the following data shall be recorded by the manufacturer and maintained as long as the data are used to satisfy 40 CFR Part 86 data requirements:

1. A continuous record of vehicle speed versus time. This record will serve the same purpose as a tach-o-graph from a test vehicle operated on the road and must reflect the service accumulation route which is submitted in the application for certification. This record is not necessary if the applicant can assure that the system design provides adequate safeguards that the dynamometer will follow the correct driving schedule throughout all service accumulation.

2. On chassis dynamometers which do not control manifold vacuum or wheel (or dynamometer) torque, a check of the engine load indicating parameter(s) is to be made at least every two hours. This record is to verify that this simulation of the original road-load requirements has been maintained. Any maintenance or load setting adjustments made to maintain this relationship must be indicated on vehicle data sheets kept by the applicant.



B. These data shall be made available to EPA upon request. If the data do not meet the requirements of this section, EPA will determine if modifications in the procedure need to be made, service on the chassis dynamometer is to be discontinued, or the vehicle must be disqualified.

Director, Office of Mobile Sources